

REMARKS/ARGUMENTS

Attached hereto is a substitute specification as Exhibits A and B. Exhibit A is the substitute specification with markings to show all the changes relative to the immediate prior version. Exhibit B is a clean version of the substitute specification. The changes were made to correct obvious errors in the English translation. No new matter is added.

Reconsideration and withdrawal of the rejections of the application are respectfully requested in view of the amendments and remarks herewith. The present amendment is being made to facilitate prosecution of the application.

I. STATUS OF THE CLAIMS AND FORMAL MATTERS

Claims 1-7 are pending in this application. Claims 1-7 are hereby amended in this response. No new matter has been introduced by this amendment.

Changes to the claims are not made for the purpose of patentability within the meaning of 35 U.S.C. §101, §102, §103, or §112. Rather, these changes are made simply for clarification and to round out the scope of protection to which Applicant is entitled.

II. CLAIM OBJECTIONS AND §112 REJECTIONS

Claims 2-7 were objected to as being unclear. These claims have been amended to improve the clarity of the claimed subject matter. Applicant requests the withdrawal of the objection in view of this amendment.

Claims 1-7 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite. These claims have been amended to improve the clarity of the claimed subject matter, thereby obviating the §112 rejection.

The Examiner has remarked in paragraph 1 of "Claims Objections" that claim 1 appears to be unclear as the device shown in Figures 2-8 and claimed in claims 2-7 appears to

have only one input and one output, and that there is no indication where a third connection might go, as is required by the illustrated connectors (7, 8 and 11) in Figure 1. Applicant submits that the enclosed amendments would sufficiently clarify the claims in so far as an end connector which is solid with the end of a terminal or end part of an electrical cable which is in turn connected to another electrical cable. A surface line is accordingly formed at least partially by successive sections of electrical cables, each section comprising the terminal or end part of an electrical cable coming from the next detonator. It follows that the end connector is solid with one electrical cable coming from a detonator, and that the end connector has output lateral pins that connect to another electrical cable (by penetrating, in use, into the inside of the other electrical cable), thereby to form the surface line. For example, for connector 11, the end connector 11 is connected to the electrical cable 10 which is attached to the firing box 9. In order to form the first part of the surface line, connector 11 is secured to the electrical cable 5 of detonator 3. At the point where the end connector 11 is secured to electrical cable 5, a terminal or end part 5a of cable 5 is defined. This terminal or end part 5a forms part of the surface line. Similarly, end connector 7 is connected to the electrical cable 5, 5a which is attached to the detonator 3. In order to form the next successive part of the surface line, connector 7 is secured to the electrical cable 6 of detonator 4. At the point where end connector 7 is secured to electrical cable 6, a terminal or end part 6a of cable 6 is defined.

III. REJECTIONS UNDER 35 U.S.C. §102 & §103

Claims 1 was rejected under 35 U.S.C. §102(b) as allegedly anticipated by U.S. Patent No. 5,714,712 to Ewick (hereinafter, merely “Ewick”).

As understood by the Applicant, Ewick discloses an explosive initiation system which comprises an electrical trunkline circuit disposed on the surface of the firing site and a

number of electric detonators, the trunkline circuit comprising one or more electrical detonators.

The trunkline circuit is connectable to a fire set capable of generating an electric signal in the trunkline circuit to fire the one or more electric detonators. One or more booster charges are disposed within one or more boreholes with at least one booster charge per borehole. Each of the booster charges is connected to a length of low energy detonator cord. *Ewick*, column 2, lines 42 to 53.

A “detonator cord” is defined in column 3, lines 55 onward as “a flexible, coilable cord having a high explosive core”, while a “low energy detonator cord” is defined as “a detonating cord containing sufficient explosive to directly initiate a booster charge”. The Examiner has accordingly erred in his assessment that *Ewick* discloses a plurality of detonators each with an electrical cable (28a to 28d), as the cords 28a to 28d shown in Figure 1 are not electrical cables, but rather low energy detonator cords (filled with explosives), these cords not having any electrical properties. The further amendments to claim 1 clarifies the present invention and clearly differentiates the present invention from *Ewick*. For example, *Ewick* does not show an end connector at the end of a terminal or end part of an electrical cable which is connected to another electrical cable to define a terminal or end part of a successive cable. Also, the surface line of *Ewick* is not at least partially formed by successive sections of electrical cables coming from the detonators.

Therefore Applicant respectfully submits that claim 1 patentably distinguishes over the relied upon portions of *Ewick*, and thus requests the withdrawal of this rejection.

Claims 1, 2, 4 and 5 were rejected under 35 U.S.C. §102(b) as allegedly anticipated by U.S. Patent No. 4,770,097 to Wilson (hereinafter, merely “Wilson”).

As understood by the Applicant, Wilson discloses a plurality of detonators (D1 to D11) which each carries an initiator (F1 to F11) adapted to fire the detonators. Each initiator is connected to respective modules (M1 to M11) by wires 6, while the modules M1 to M11 are connected to one another by trunk wires 10. As described in column 3 lines 14 to 21 of Wilson, each of the modules M1 to M11 is encapsulated in a connector 14 having prongs 16 on one side and a corresponding socket 18 on an opposite side. Adjacent connectors 14 are connected by lengths of electrical cable 20 carrying the trunk wires 10 and having connecting elements 22, 24 at opposite ends thereof.

From this description and particularly from Figure 3, it is obvious that the surface line is formed by separate lengths of electrical cable carried in the trunk wires 10 which are only connected to the wires 6 by the modules M1 to M11 encapsulated in the connectors 14. The surface line is not formed (as claimed in amended claim 1 of the present invention) by successive sections of the electrical cables coming from the plurality of detonators. Also, the connectors of the electrical cables do not define the origin of the next detonator's terminal or end part as now claimed in claim 1.

For at least the foregoing reasons, Applicant submits that claim 1 patentably distinguishes over the relied upon portions of Wilson, and therefore is allowable.

As to the rejection of claim 2 in view of Wilson, and particularly referring to "Attachment A" provided by the Examiner, Applicant submits that the present invention claims a connector having a first part solid with an end of an electrical cable coming from a detonator. The Examiner has interpreted Figure 3 of Wilson to include such a first part (22), although the electrical cable (20) of this part does not come from a detonator, but the first part is only connected to the detonator (not shown) through a separate connector (14) and electrical cable (6).

It is further clarified that claim 2 claims that the connection pins (21, 22, 23) are to penetrate, in use, into the inside of an electrical cable coming from another detonator. This feature and configuration are not disclosed by Wilson.

The Examiner has interpreted Figure 3 of Wilson to comprise a “seat”, as indicated in “Attachment A”. Applicant disagrees. Claim 2 specifically claims that the “seat is suitable for receiving an electrical cable”. The seat as pointed out by the Examiner in Attachment A is merely a surface or connection point in the module and is not described in any detail in the prior art document. Further, the description of the specification of the present invention in the second sentence of the second full paragraph on page 5, it is described that “the stop wall 43 has a fillet 45 which together with a bead 46 to the side of this fillet 45 forms a partial **cradle** so as to wedge into the seat formed between the stop wall 43 and the slide 37 and near the wall 40, a roughly cylindrical body that will be inserted into it, which body has a longitudinal axis extending perpendicularly to both the volume 33 and the volume 34 of the first part 20 when it cooperates with the second part 36”. From this description, and from the integer the “seat is suitable for receiving an electrical cable”, the context of “seat” in claim 2 should be construed to be “a part that supports or guides another part” (Oxford Dictionary) and not merely a position of a particular component, as construed by the Examiner from Figure 3.

Claims 3, 6 and 7 were rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Wilson in view of U.S. Patent No. 5,659,149 to Sutula (hereinafter, merely “Sutula”).

Applicant respectfully submits it would further be inappropriate to combine Sutula with Wilson, as Sutula relates to a non-electrical initiation system (column 3, line 10) wherein signal transmission lines, e.g., detonating cords, shock tubes, low velocity signal tubes

or low energy detonating cords are used during detonation. It should be noted that none of these signal transmission lines are electrical in nature and that the further background information incorporated into the description (e.g., US Patent No. 5,171,935 and US Serial No. 08/576,003 granted as US 5,703,320) all relate to non-electrical initiation systems.

Applicant respectfully submits that nothing has been found in Ewick, Wilson or Sutula, that would teach or suggest the above-identified features of the instant claims. Specifically, none of the cited references, taken alone or in combination, teach or suggest a pyrotechnical firing installation for use in a firing program, the firing installation comprising a plurality of detonators, each detonator provided with an electrical cable comprising an end connector at the end of a terminal or end part of the electrical cable and at least two connection conductors, and a surface line to which the electrical cable of each detonator is connected via the electrical cable's end connector, wherein the surface line is at least partially formed by successive sections of the electrical cables of the plurality of detonators, every section comprising the terminal or end part of one of the electrical cables coming from one of the plurality of detonators and the end connector of the electrical cable, thereby to electrically connect the terminal or end part of one electrical cable to the electrical cable of the next detonator, to define the origin of the next detonator's terminal or end part anywhere on the electrical cable of the next detonator, as recited in claim 1.

Therefore, Applicant respectfully submits that claim 1 is patentable. The other claims in this application are each dependent from independent claim 1 discussed above and are therefore patentable for at least the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

The Examiner has apparently made of record, but not applied, several documents. The Applicants appreciate the Examiner's implicit finding that these documents, whether considered alone or in combination with others, do not render the claims of the present application unpatentable.

CONCLUSION

In view of the foregoing amendments and remarks, Applicant respectfully submits that all of the claims are in condition for allowance and requests early passage to issue of the present application.

In the event the Examiner disagrees with any of statements appearing above with respect to the disclosure in the cited references, it is respectfully requested that the Examiner specifically indicate those portions of the references providing the basis for a contrary view.

The Commissioner is authorized to charge any additional fees that may be required to Deposit Account No. 50-0320.

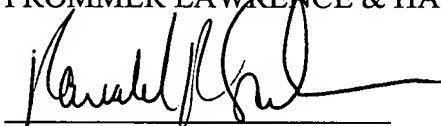
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EXHIBIT A
MARKED-UP VERSION OF SUBSTITUTE SPECIFICATION

PYROTECHNICAL FIRING INSTALLATION

BACKGROUND OF THE INVENTION

In mines and quarries the breaking of rocks is carried out by means of explosives.

A firing program consists of making a plurality of drill-holes in the rock, which are filled with explosives with, for every drill-hole, a detonator that permits the firing. Some of these detonators are electronically controlled, which makes it possible to program the setting off of the explosions according to a predetermined firing plan.

The execution of a firing plan consists, therefore, after having arranged all the detonators in the drill-holes that have been made and connecting them to a control unit or firing box, of identifying every detonator by a serial number and applying to it a delay time which will determine the moment of ignition of the charge in relation to a general firing signal.

Electronic detonator systems receive power and control signals from a bus or surface line, connected to the firing box and extending over the firing range so as to connect all the detonators.

A detonator generally comprises an electronic module in the form of a tubular sheath, one end of which is provided to receive the pyrotechnical blasting cap. From the other end of this tubular sheath there exits an electric-electrical cable with a length roughly equal to the drilling depth of the drill-holes. The end of this cable carries connection means such as, for example, clips that make it possible to connect each of the wires, without baring them, to the two-wire line running over the firing range.

The putting into position of the ground bus or surface line of the firing range is a very inconvenient operation. Furthermore, the connection of each of

the detonators to this line requires special attention and creates a risk of errors.

SUMMARY OF THE INVENTION

The present invention aims to remedy these drawbacks mentioned above by doing away with the two-wire bus so that every detonator is equipped with only one cable for its connection to the programming and firing control means and to the other detonators of the firing plan.

To this end, the invention accordingly relates to a pyrotechnical firing installation comprising a plurality of detonators each with an electric electrical cable comprising at least two conductors, and a surface line to which the cable of each detonator is connected, wherein the surface line is formed by sections, every section comprising a terminal or end part of the electric electrical cable coming from a detonator and an end connector to electrically connect this terminal part to the cable of the next detonator at a point of the latter defining the origin of its terminal part.

In this way, the bus or surface line is formed as the detonators are connected to one another. It, therefore, is no longer necessary to use a special cable for forming the bus. Moreover, the connector permits the connection of a first detonator at any place whatsoever of the cable of the next detonator, so that one can provide a constant connecting cable length for all the detonators.

The invention also relates to a detonator comprising an electric electrical cable, the free end of which is provided with a connector for implementing the abovementioned installation, the connector comprising a first part solid with the end of the cable, provided laterally with connection pins and on the opposite side to these pins a pushing wall, and a second part comprising a slide and a stop wall, into which the first part is mounted movable in relation to the stop wall which faces the connection pins, the wall and the slide

defining a seat suitable for receiving an ~~electric~~electrical cable oriented transversely to the cable equipped with the connector.

Thus, by means of this connector one can produce a lateral connection of the end of a cable to any place along the cable of the next detonator.

Other characteristics and advantages of the invention will be noted from the description given below by way of non-limitative example, of an exemplified embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

Reference will be made to the attached drawings, wherein:

Figure 1 is a diagram illustrating a pyrotechnical firing installation according to the invention;

Figures 2, 3 and 4 illustrate in a front, bottom and top view respectively, one part of a connector according to the invention;

Figures 5 and 6 illustrate in a front view and a side view a second part of a connector according to the invention; and

Figures 7 and 8 illustrate the cooperation of these two parts for the electrical connection of two successive detonator cables.

DESCRIPTION OF AN-THE PREFERRED EMBODIMENTS

The diagram of Figure 1 shows two blast-holes 1 and 2 belonging to a firing plan or program, in which are arranged two detonators 3 and 4, each of which is provided with an ~~electric~~electrical cable 5, 6 having at least two conductors coming out of the respective blast-hole. Each of the cables 5, 6 comprises at its free end a respective connector 7, 8. A central control unit or firing box 9 is equipped with an ~~electric~~electrical cable 10, the end of

which is also provided with a connector 11. The connector 7 at the end of cable 5 according to the invention can be mounted on the cable 6 and ensure the electrical connection of the wires, or of some of them, of the cable 5 and cable 6. The connector 7 is placed on the cable 6 at a point which forms the origin of the terminal or end part 6a of cable 6. Likewise, the connector 11 of the cable 10 defines the terminal or end part 5a of cable 5. In this way the surface line, with the exception of cable 10, is formed by successive sections, which are the terminal parts 5a, 6a of the cables 5, 6. It will be understood that in this way there no longer is a special cable dedicated to the formation of a surface bus for the control and power supply of the detonators of a firing installation.

Figures 2 to 6 illustrate a special embodiment according to the invention of a connector such as 7, 8 or 11. The illustrated connector comprises a first part 20, for example of plastic material overmoulded at one end by a cable such as 5, 6 or 10, this first part 20 comprising four lateral pins 21, 22, 23, connected electrically to three conductors 25, 26, 27 of the electric electrical cable, and a terminal 24 connected to a test wire 28. On the opposite side to the connection pins, the part 20 comprises a push wall 29 prolonged on the opposite side to the cable 5, 6, 10 by a flexible tab 30, which extends perpendicular to it and is provided with an opening 31 and a terminal gripping part 32. As illustrated, the part 20 has a cylindrical volume 33 in the extension of the electric electrical cable, a cylindrical volume 34 which is perpendicular to the volume 33 and has roughly the same diameter, from one end of which the pins project, whereas at its other end the volume 34 is connected to the push wall 29, which in turn is connected to the cylindrical volume 33 by a partition 35.

In Figures 5 and 6, the second part 36 of the connector according to the invention is shown, which comprises a slide 37 formed by two walls 38 and 39 and an end wall 40 perpendicular to these two walls 38, 39. The inside surface of the wall 40 is connected to the inside surfaces of the walls 38 and 39 by a cylindrical surface congruent with the cylindrical surface of the volume 34 of the part 20. The distance between the walls 38 and 39 is

practically equal to the diameter of the cylindrical volume 33 of the part 20, whereas in the upper part these walls are provided with at least one inside bead 41, 42, which slightly reduces the distance between them, so that the inserting from above of the part 20 into the slide 367 requires a small amount of force in order to pass these beads.

The end wall 40 is prolonged under the slide 367 and has a part or stop wall 43 extending from it at a right angle, which forms a stop wall facing the bottom opening of the slide. This stop wall 43 ends in an inclined gripping part 44, and at the point where it connects to the part 40, it has a fillet 45 which together with a bead 46 to the side of this fillet 45 forms a partial cradle so as to wedge into the seat formed between the plate-stop wall 43 and the slide 366 and near the wall 40, a roughly cylindrical body that will be inserted into it, which body has a longitudinal axis extending perpendicularly to both the volume 33 and the volume 34 of the first part 20 when it cooperates with the second part 36. It will also be noted that there is an opening 43a in the right-angle stop wall 43, which opening is located just to the right of the place of the slide that receives the body-volume 34 of the part 20.

Finally, it will be noted that there is a lug 47 on the outside surface of the end wall 40, which lug 47 is intended to penetrate into the opening 31 of the tab 30 of part 20.

The two parts of the connector of the invention are assembled in the waiting position illustrated in Figure 7. In this position the pins 21, 22, 23 are retracted inside the slide 367 so that one can insert into the cradle formed by fillet 45 and bead, 46 a cable 5 or 6, cylindrical but preferably having a flat side 48 (see Figure 8) parallel to the bundle of conductors 25, 26, 27 which it encloses. When, as in Figure 8, the cable 5, 6 is in position in the cradle, the connection is ensured by pushing on the plate-wall 29, which moves the part 20 towards the stop wall 43 of the part 36, forcing the pins to penetrate into the inside of the cable 5, 6 until they reach the bundle

of conductor wires. The connection position of the two parts 20 and 36 is then locked by the penetration of the lug 47 into the opening 31.

The special shape of the cable 5, 6 illustrated in Figure 8 constitutes a locating device for the putting in place of the connector on a detonator cable and guarantees a good electrical connection. It must be mentioned that in its position illustrated in Figure 7, the connector according to the invention permits the carrying out of control tests by introducing into the cradle 45, 46 a test probe, which will feel the pins and terminal of the part 20 so as to proceed with usage verifications before the detonator corresponding to the connector is connected to the next detonator cable. This probe is introduced into the opening 43a. It will be noted that in the presence of a cable this opening is closed off, which prohibits any measuring tests of a detonator already connected to the firing installation.

Taking into account the shape of the cable and its cooperation with the inside surface of the slide 367, the tightness of the connection is ensured. The gripping parts 32 and 44 of the tab 30 and stop plate-wall 43 make it possible on the one hand to disconnect the pins so as to pull them out of the cable and on the other hand to disengage the cable from its seat in the cradle.

Because of the invention it is possible to produce on the ground a run of relatively tight wires since the connection of a cable to the next cable can be made anywhere. In this way one can take into account the different distances that separate the blast-holes in a firing plan without the ground being encumbered by a surplus length of electric-electrical cables in which the feet of workers can become entangled and inopportunely break the connections.